RESEARCH HIGHLIGHT

July 2004

Technical Series 04-113

INSTALLATION GUIDE FOR RESIDENTIAL WOOD I-JOIST FLOOR SYSTEMS

BACKGROUND

In 2000/01, Canada Mortgage and Housing Corporation (CMHC) conducted a feasibility study to determine the need and viability of producing a guide to help builders use wood I-joists correctly. The research indicated strong support from the various stakeholders, including I-joist manufacturers, for the development of a generic guide.

INTRODUCTION

Wood I-joists have become a common product for framing residential floors. While these products have been available for many years, they are still relatively new to some builders. CMHC and the Canadian Home Builders' Association commissioned the development of the *Installation Guide for Residential Wood I-joist Floor Systems* to help builders use and install wood I-joists safely and effectively.

Wood I-joists are engineered wood products. This means they are manufactured and quality controlled to increase the reliability of their engineering properties (strength, stiffness etc.). They are manufactured to a variety of specifications under controlled conditions. Their flanges are either dimension lumber or finger-joined lumber, or laminated veneer lumber (LVL) for longer joists. The webs are made from plywood or oriented strandboard (OSB).

Wood I-joists have long span and high load capability relative to dimension lumber floor systems. This is the main reason why builders using wood I-joists for the first time need to learn the framing techniques and principles unique to I-joists. In addition, wood I-joists are proprietary products. This means the design values are not standardized, as for lumber, and the capabilities of I-joists (span, nailing patterns, etc.) and some installation details vary from one manufacturer to another. Each time a builder uses a different I-joist product, there is a new set of rules to be followed, and in some cases the installation instructions don't make it out to the construction site. This can result in confusion and the potential for structural deficiencies. The understanding of basic principles can help builders avoid installation difficulties when they build wood I-joist floor systems.

PURPOSE

The Guide presents general information and numerous illustrated details such as web stiffeners, squash blocks, stringer connectors, etc. that are common to all wood I-joists. The guide also includes information on other related topics such as proper storage and handling. It is intended to help builders and renovators understand the basics for good wood I-joist floor installations. The Guide is not intended in any way to supplant the technical literature and support provided by the manufacturers. Rather, it is intended to supplement manufacturers' information by explaining how to install wood I-joists effectively and safely. The guide will also be beneficial to building officials and inspectors.

To encourage use of this information on site, an abridged version of the report, a Pocket Guide, has also been developed.

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METHODOLOGY

Steering Committee

A Steering Committee was formed representing the residential construction industry, building officials, home warrantors, wood industry associations and wood I-joist researchers, manufacturers and regulators. Several conference calls took place to define the project, direct the content of the report, and correct and refine the information as it was drafted.

RESEARCH

Literature from all manufacturers that distribute wood I-joists in Canada (table below) was acquired and reviewed.

All wood I-joists approved for use in Canada are evaluated by the Canadian Construction Materials Centre (CCMC) to ensure the joists comply with the intent of the National Building Code of Canada (NBCC). Table 1 shows the wood-I-joists that were evaluated for use in Canada at the time this research was done. Details are posted at **http://irc.nrc-cnrc.gc.ca/ccmc**

Table 1 Wood I-joists approved for use in Canada (as of December 17, 2003)

CCMC Evaluation Number	Manufacturer	Product
10458R	Jager Building Systems Inc.	JSI™ 20 series I-Joists
11094R	Louisiana-Pacific Corporation	Louisiana-Pacific LPI, LPI (CTR) and TLI Series Joists
12412R	Louisiana-Pacific Corporation	LPI-32 Series I-Joists
12473R	Boise Cascade Corporation	BCI®/45 Joists
12474R	Boise Cascade Corporation	BCI®/60 Joists
12564R	Nascor Incorporated	NJ10, NJ12, NJH10, NJH12, #2 and Better Series I-Joists
12655R	Jager Building Systems Inc.	JSI 30, 40, 42 & 44 Series I-joist
12724R	Louisiana-Pacific Corporation	LPI-20 and LPI-20X1.7 Series I-Joists
12751R	Structures de Bois Supérieures Ltée	SIB 30, 31, 41 Series I-Joists
12768R	International Beams Inc.	IB 400, 600, 800 Series I-Joists
12787R	Boise Cascade AllJoist Limited	Alljoist® Series I-Joists
12832R	Trus Joist, A Weyerhaeuser Business	TJI® Series Joists
12933R	Jager Building Systems Inc.	JSI™ 25 series I-joist
13014R	D.F. Floor Joist (1065430)	PRO-Joist PRI-20 and PRI-40
13032R	Nordic - Bois d'ingeniere	Nordic I-Joist Series PRI-20, PRI-40, NI-40x/IPI-400x, PRI-60, PRI-80
13044R	Alpa Floor System Inc.	Alpa QFS® Joist Series, QFS-A310E, A312E, A314 and 314M
13045R	Alpa Floor System Inc.	Alpa QFS® I-Joist Series, QFS-B310, B312 and B314
13053R	Anthony-Domtar Inc.	Power Joist™ ADI-40, ADI-60, ADI-80 I-joists
13064R	Nexfor Inc.	Norbord I-Joist

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From this review, a selection of common details was proposed to the Steering Committee, which resulted in the inclusion in the guide of about 30 details that are illustrated and explained.

REPORT

At a certain point in the project evolution, it was determined that successful I-joist floor installation is dependent on the understanding and implementation of nine basic principles (see Basic Principles for I-joist Installations). The essential wood I-joist installation details that were needed to support these principles were selected and drawn to suit the report style and information needs.

POCKET GUIDE

The Pocket Guide will be printed and made available to builders, renovators and building officials as an on-site reference.

VALIDATION

In addition to the Steering Committee industry representation, the final draft of the Research Report was circulated to four key Canadian I-joist distributors including members of the Wood I-Joist Manufacturers' Association (WIJMA) for their review and comments. The Pocket Guide was circulated to key builders for comment. Following these two industry reviews, the drafts were revised to reflect these reviews.

MAIN FINDINGS

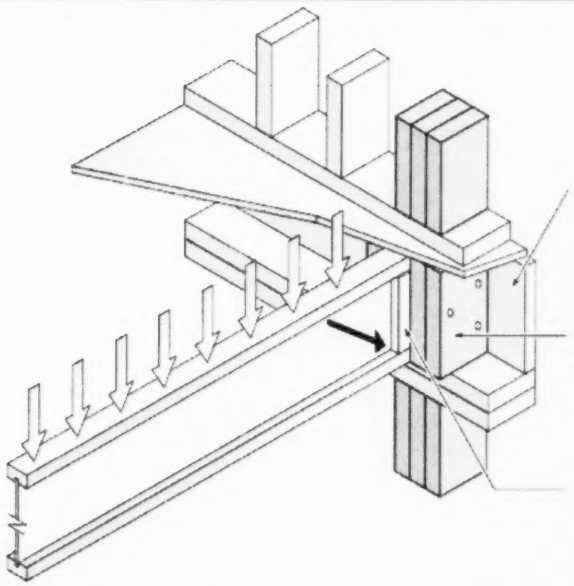
Based on the review of wood I-joist literature and discussions with industry experts, it became evident that good installation of wood I-joist flooring systems comes down to several straightforward areas that require understanding and implementation. Called the *Basic Rules for Wood I-joist Installations* in the report, these good practices are summarized as follows:

General

1. Storage and handling
2. Installation
3. Span charts
4. Holes in wood I-joists
5. Bearing length
6. Offset walls

Load Transfer (See Figure 1)

7. Rim framing
8. Squash blocks and blocking
9. Web stiffeners



Rim framing transfers exterior wall loads around the I-joists to the wall below.

Blocking transfers interior wall loads around I-joists to the wall or beam below.

Squash blocks are used to transfer point loads from columns or framing around doors and windows from one floor to the next without loading the I-joists.

Web stiffeners may be required if the load on the joist exceeds the design capacity of the joist without web stiffeners.

Figure 1 Load transfer mechanisms

STORAGE AND HANDLING

Wood I-joists are engineered products manufactured to set standards under controlled factory conditions. The investment in quality building materials should encourage builders to store and handle wood I-joists carefully.

INSTALLATION

Wood I-joists will not support workers or other loads until the joists are properly fastened and braced. No loads other than the weight of the workers should be placed on the joists until sheathing is permanently installed.

SPAN CHARTS

The span capabilities of wood I-joists vary by manufacturer. It is important to consult the manufacturer's span charts and build accordingly.

HOLES IN WOOD I-JOISTS

Wood I-joists are structural members designed to transfer floor loads to the joist supports. Field modifications to the webs or flanges can have a serious affect on the capability of the joists to perform. For this reason, the cutting, notching or relocation of framing members, especially by sub-contractors that may not be aware of the structural consequences of unauthorized modifications, has always required vigilance.

BEARING LENGTH

The size of the loads carried by I-joists can be considerable. All the weight is transferred from the floor to the bearing walls via the point of contact between the lower I-joist flange and the bearing plate. The usual minimum joist end bearing for wood I-joists is 45 mm (1-3/4"), but some manufacturers permit slightly less.

OFFSET WALLS

Offsets dramatically increase shear loads in the web. At this time, there is no general direction for handing offsets and an offset of any size is a definite reason to seek technical assistance from the manufacturer or from an engineer.

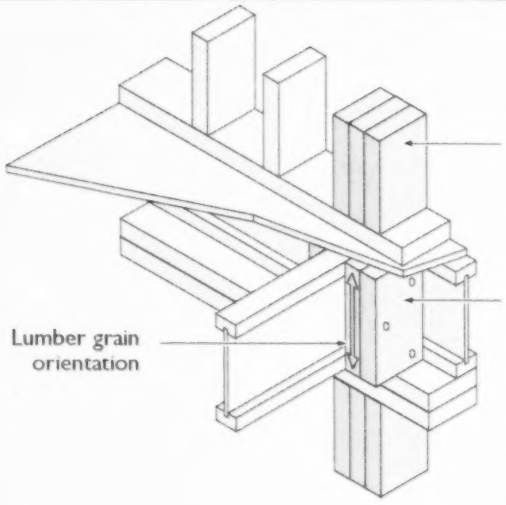
RIM FRAMING

In wood I-joists systems, rim framing not only encloses the floor around the perimeter, but also serves the essential structural function of transferring bearing wall loads to the wall below instead of into the ends of the joists.

BLOCKING

Two types of blocking are used for load transfer.

1. Squash blocks are used to transfer loads around I-joists for continuous bearing wall loads, squash blocks are installed to transfer point loads from posts and columns around, rather than through, I-joists. (See figure 2)
2. Blocking is used between joists. It is required a) at interior supports where there is a load-bearing wall and b) where floor joists are not continuous over supports, even if there is no load-bearing wall above.



Wherever point loads are delivered to wood I-joists from a column or post, **squash blocks** (blocking) are required to transfer the load around the thin I-joist web.

Squash blocks keep the web from buckling or from knifing into the lower flange. The bearing area of the squash blocks must be at least as large as the bearing area of the post or column.

In this case, the column is comprised of three studs and thus three squash blocks are required – two on one side of the I-joist, and one on the far side.

Lumber squash blocks must be cut to extend 1.6 mm (1/6") above the I-joist to ensure that shrinkage in the lumber does not result in the vertical load being acquired by the I-joist.

Check capacities and nailing requirements.

Figure 2 Squash blocks transfer point loads around the ends of the I-joists

WEB STIFFENERS

Web stiffeners are reinforcements attached to either side of a wood I-joist web over end supports or under a concentrated load.

In addition to the basic principles that apply to all I-joist installations, the Report has a section called *Related Topics* that deals with subject matter that may arise, but is not relevant for every I-joist installation. The topics included are:

- Rim framing over openings
- Cantilevers
- Fire and sound performance
- Framing to headers and steel beams (Figure 3)
- Foundation wall support

Glossary of related terms is included in the research report.

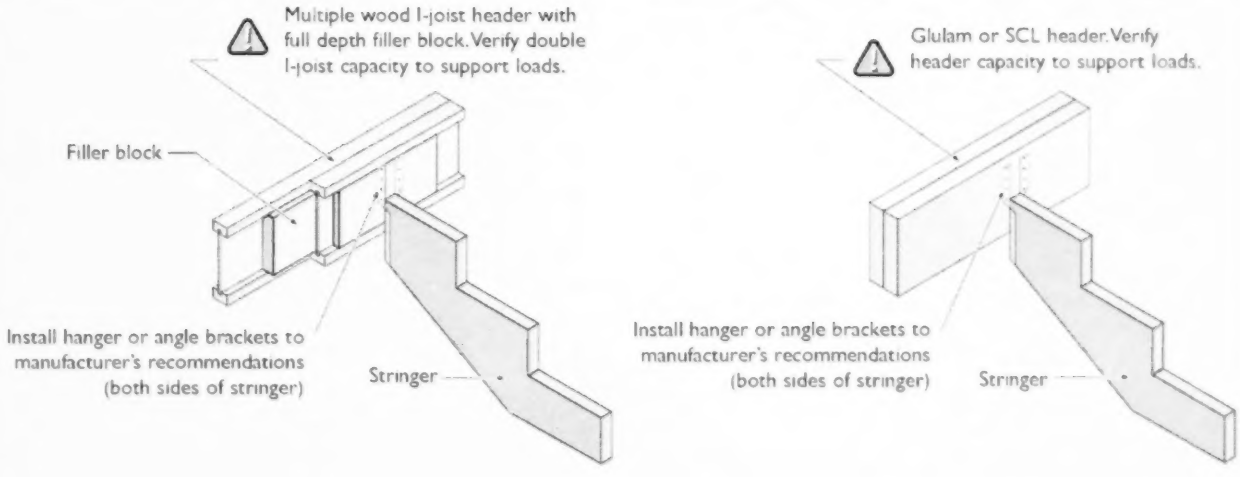

Multiple wood I-joist header with full depth filler block. Verify double I-joist capacity to support loads.
Filler block
Install hanger or angle brackets to manufacturer's recommendations (both sides of stringer)
Stringer
Glulam or SCL header. Verify header capacity to support loads.
Install hanger or angle brackets to manufacturer's recommendations (both sides of stringer)
Stringer

Figure 3 Attachment of stair stringers.

CONCLUSIONS

Wood I-joists have become an important component of residential construction. The long span capability and high load capability, and their different profile and properties relative to dimension lumber mean different and specific installation procedures that builders need to understand and implement.

The *Installation Guide for Residential Wood I-joist Floor Systems* describes the main rules for good wood I-joist installations and encourages builders to follow manufactures proprietary detail information and utilize the technical support provided by wood I-joist manufacturers.

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

To purchase the *Installation Guide for Residential Wood I-joist Floor Systems* or to find more *Research Highlights* plus a wide variety of information products, visit our Web site at

www.cmhc.ca

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